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(54) **Cups of deformable material**

(57) A cup of deformable material comprises a bottom wall and a sidewall extending generally upwards and outwards from the bottom wall, the cup including lower, external and upper, internal retaining means (7, 6) which, when an upper and a lower cup, in upright attitude, are in nesting engagement, cooperate to resist separation of the cups, but permit the cups to be separated by external forces. The cup (Fig. 1) is formed without one at least of the retaining means, and thereafter the absent retaining means (Fig. 2) is produced by local application of heat and force (at 4) to the sidewall of the cup.



Fig.1.

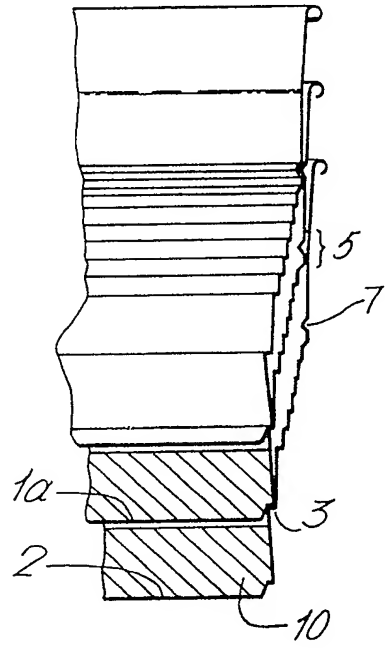


Fig.2.

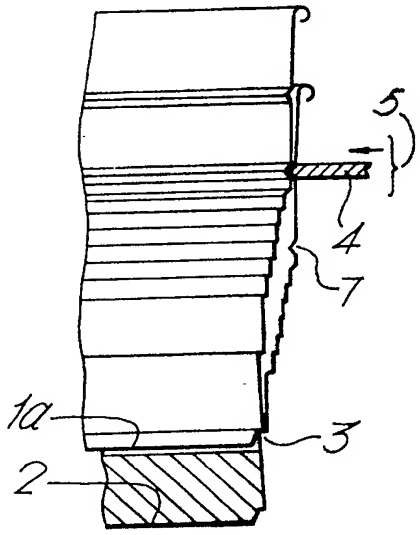


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Fig.1.

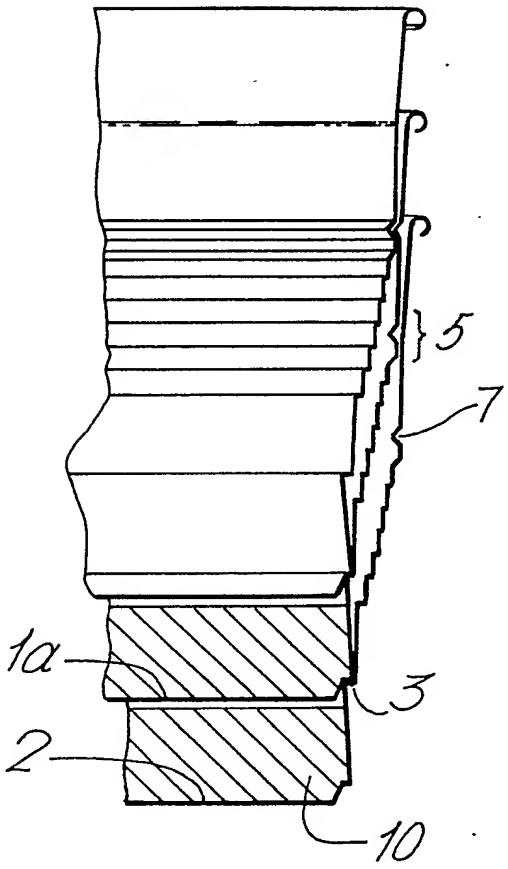


Fig.2.

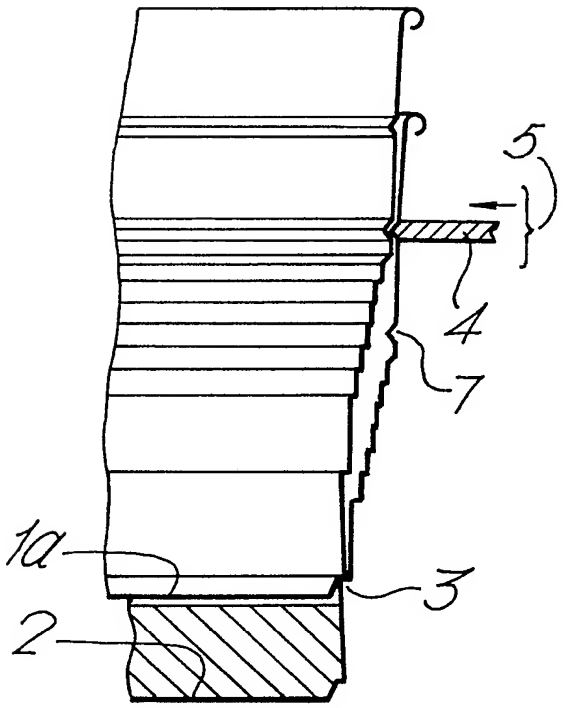


Fig.3.

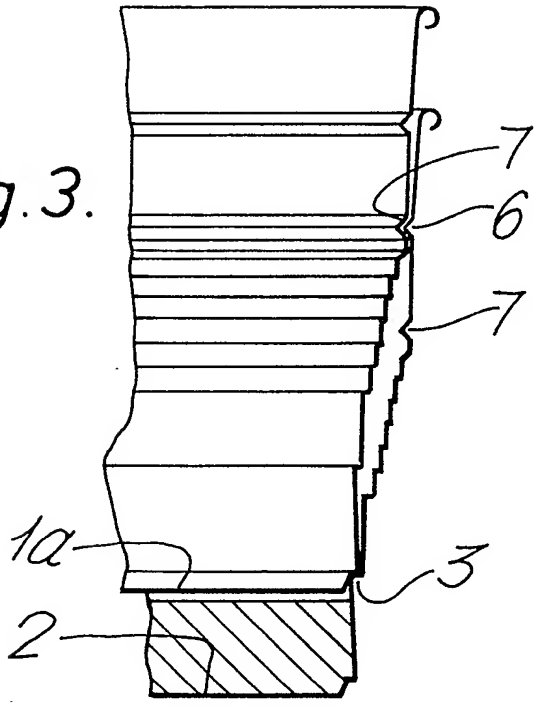

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Fig.4.

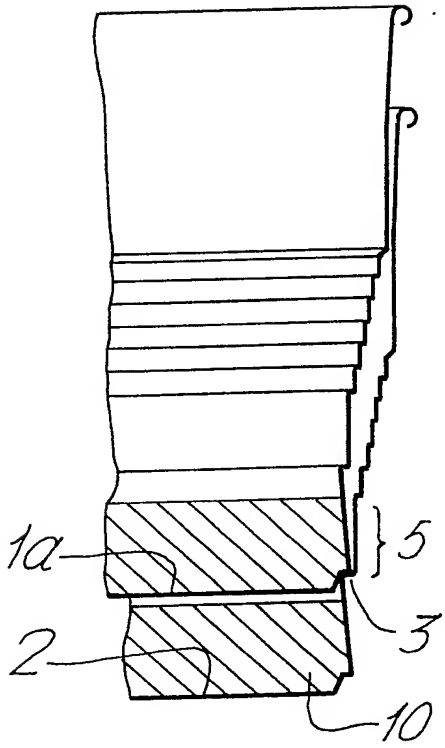



Fig.5.

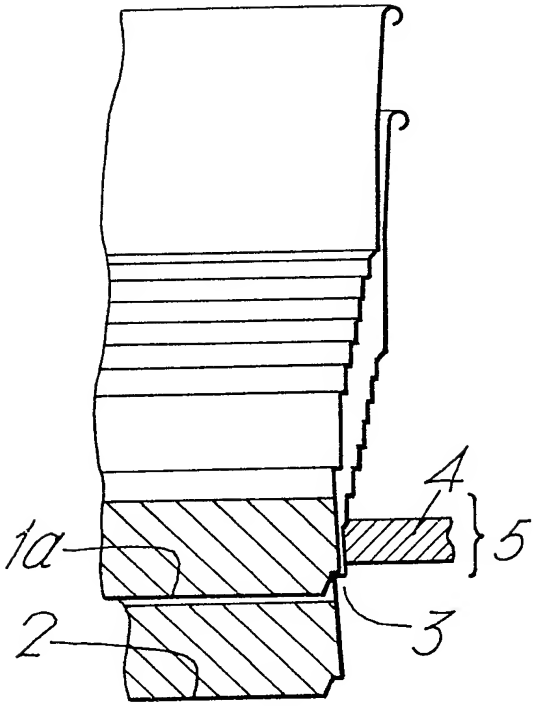



Fig.6.

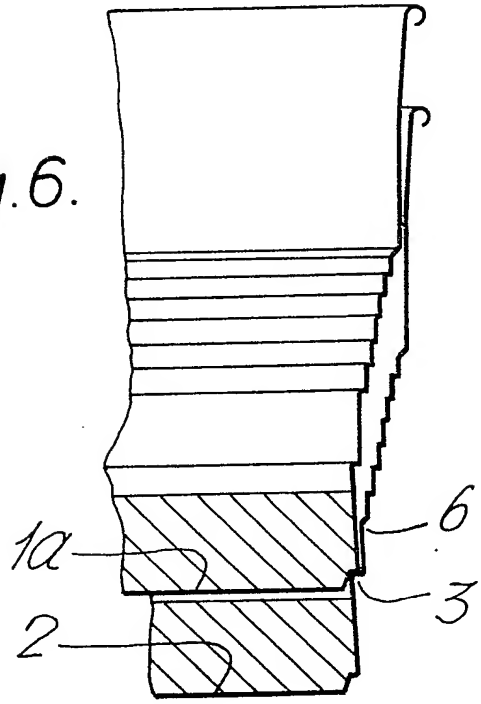


Fig.7.

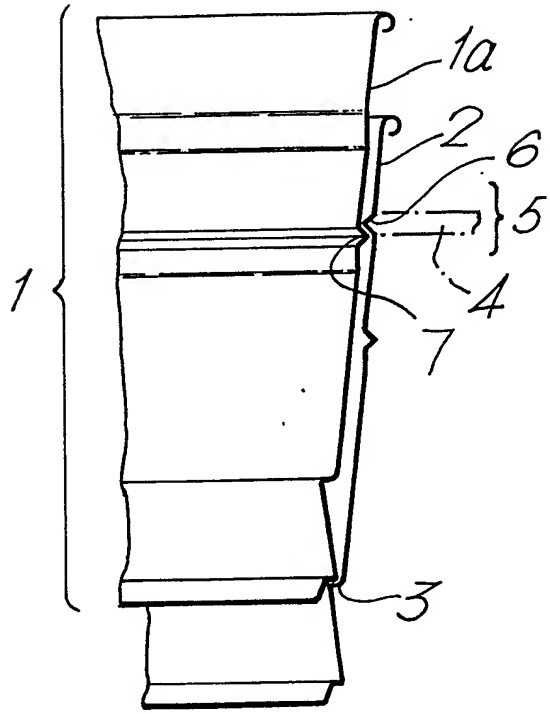



Fig.8.

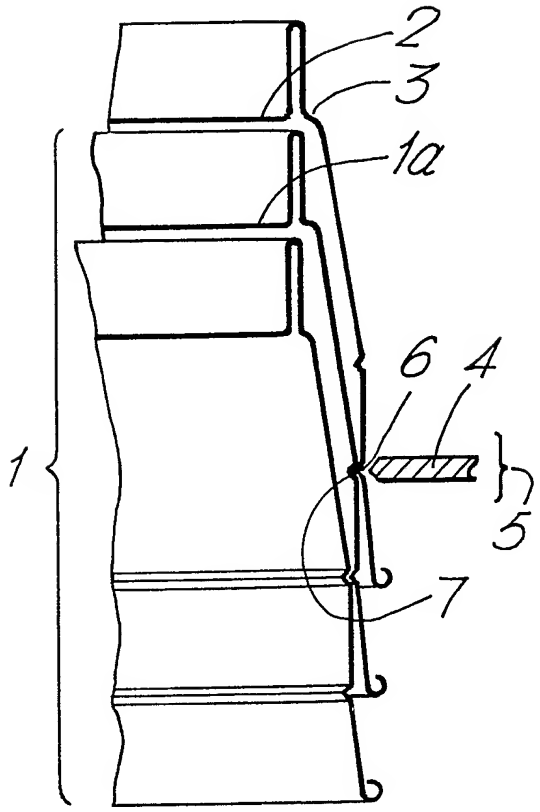



Fig.9.

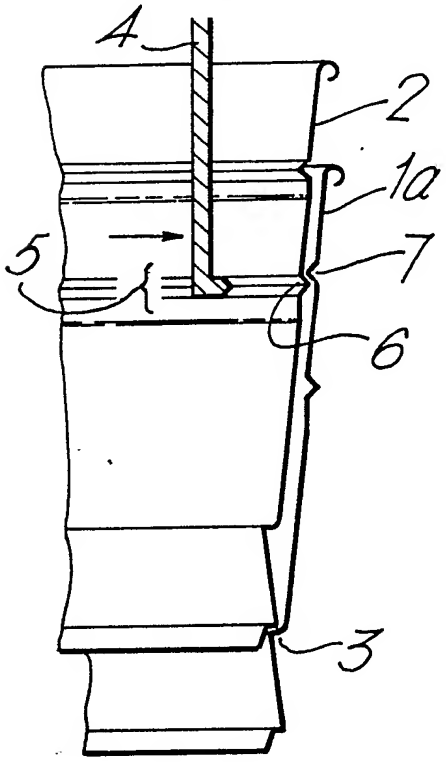


Fig. 10.

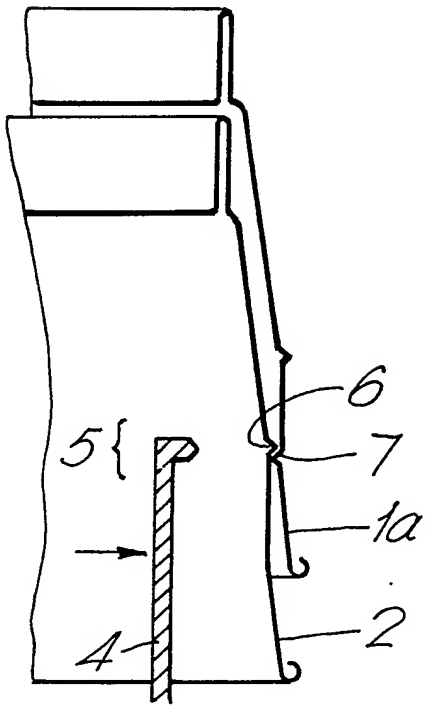



Fig. 11.

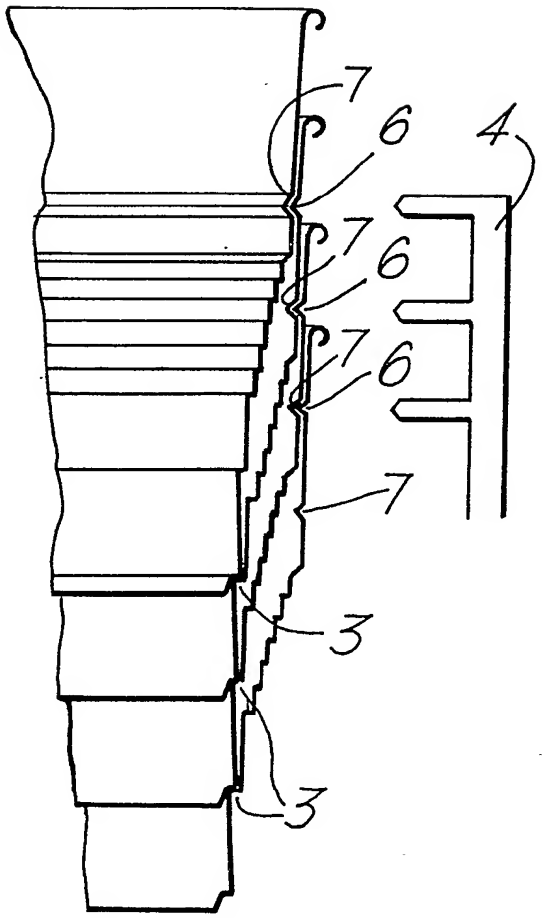


Fig. 12.

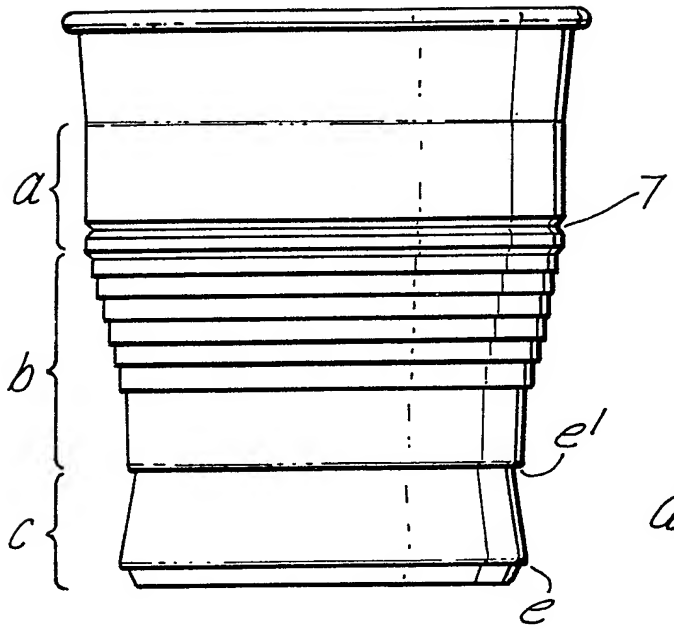



Fig. 13.

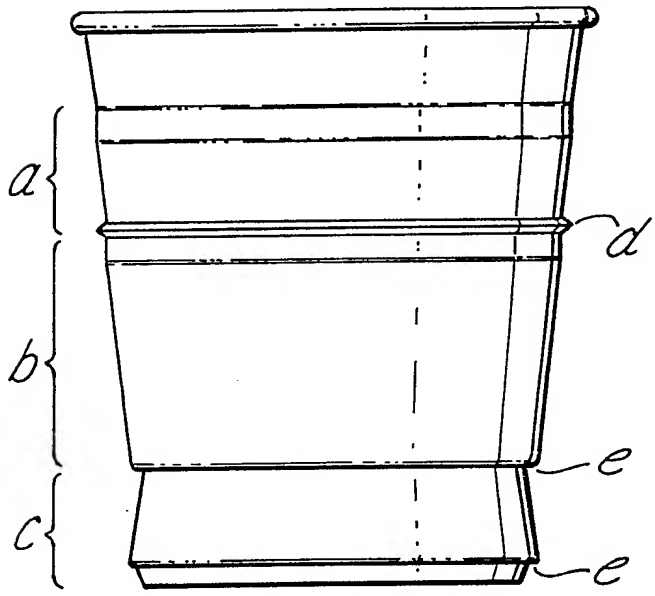
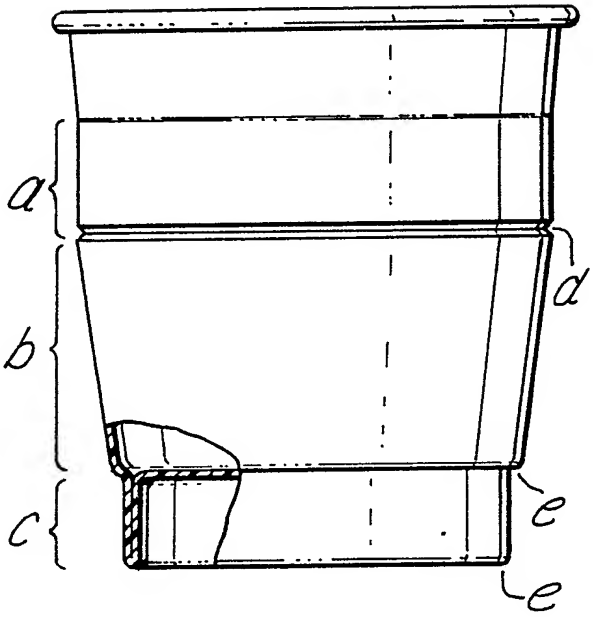



Fig. 14.



SPECIFICATION

**Cups of deformable material**

This invention relates to cups of deformable material capable of nesting with identical cups to form a stack, each cup comprising a bottom wall and a sidewall extending generally upwards and outwards from the bottom wall, the cup including lower, external and upper, internal retaining means which, when an upper and a lower cup, in upright attitude, are in nesting engagement, cooperate to resist separation of the cups, but nevertheless to permit the cups to be separated by external forces. Most usually nowadays cups of this kind are made of a thin thermoplastic material, a common example being polystyrene. The invention is, however, applicable to cups of any material which, in the thickness used, is deformable. Another example is waxed paper.

Such a cup will be referred to below as "a cup of the kind specified".

One use of such cups is as so-called "ingredient cups". Such cups are assembled together in a stack with a measured quantity of powdered ingredient in each of the spaces defined between the bottom walls of adjacent cups. Typically such an ingredient serves to provide a beverage when a single cup is separated from the stack and is filled with hot water.

The normal commercial procedure is for the cups to be manufactured at one place, and then shipped to a second place where the powdered ingredient is supplied. It is therefore necessary for the cups to be transported from the first place to the second place, then separated, and then assembled into a stack, usually by adding the cups one by one to a stack as ingredient is supplied into each successive cup.

A problem with such a procedure is that, if the cups are shipped from the first place to the second place assembled together in a stack (but without any ingredient), then mechanism is required at the second place to separate the cups from the initial stack, overcoming the restraining action of the retaining means. Alternatively, before shipping from the first place to the second place, the cups may be assembled into a preliminary stack, without pushing the retaining means into interengagement. If this is done, the "stacking height", that is to say the distance between the bottom walls of adjacent cups, is considerably greater than the stacking height in a fully nested stack, and consequently the space occupied by the cups during shipping is increased.

The present invention concerns a procedure which overcomes these problems.

According to the present invention, a cup of the kind specified is made by a method comprising forming the cup without one at least of the retaining means, and thereafter producing the absent retaining means by local application of heat and force to the sidewall of the cup.

In practice, the forming without the retaining means is carried out by a cup manufacturer at what has been called above "the first place", while the production of the absent retaining means is carried out at the second place, in association with the supply of ingredient to the cups. The cups can be shipped from the first place to the second place in a stack in fully nested engagement, and can be readily separated from one another at the second place.

The production of the absent retaining means may be carried out either after supply of ingredient to the space between a cup and an adjacent cup, or between the step of separating the cups, and of supplying the ingredient.

For simplicity, the following detailed discussion will concern itself only with producing the absent retaining means after the supply of ingredient.

Reference is now made to the accompanying drawings:—

*Figure 12* is a side elevation of a cup which has been formed without upper, internal locking means.

*Figure 1* shows three such cups. The upper and middle cup are the lowest two cups of a stack, while the lower cup has just been added to the bottom of the stack. The upper and middle cups have already been retained together by production of an upper, inner locking means on the middle cup, in engagement with the lower, outer locking means on the upper cup. The lower cup still lacks its upper, inner locking means; that is to say the lower cup has the shape shown in Fig. 12. The cups shown are of thin thermoplastic material.

Ingredient has been supplied at 10 to the space between the bottom walls 1a and 2 of the middle and lower cup. The lower cup is being forced upwards (by means not shown) relatively to the stack, so that sealing enagement occurs between the lower and middle cup at 3. For this purpose, each cup, as shown in Fig. 12, has a lower external step *e*, and an upper internal step *e'*.

*Figure 2* shows only the middle and lower cup of Fig. 1 during production of upper, inner locking means on the lower cup. This locking means is produced by a heated tool 4, which is forced against the side wall of the lower cup in the zone 5, and thereby deforms the sidewall so as to produce an internal rib, as shown at 6 in Fig. 3, in engagement with an existing external groove 7 in the middle cup.

After formation of the internal rib 6, the tool 4 is withdrawn radially to the right, leaving the middle and lower cup in nesting engagement, locked together, as shown in

Fig. 3. Thereupon, what has so far been referred to as the middle and lower cup can perform the function of upper and middle cup in Fig. 1, the stack being moved upwards by a distance equal to the stacking height, and a new lower cup, containing a supply of ingredient, being added to the bottom of the stack, and urged upwards.

The fact that the lower cup is urged upwards during formation of the internal rib 6 means that, upon release of the upward force on the lower cup, the sidewalls of the cups in nesting interengagement are in a state of stress, sufficient to hold together the steps forming the seal at 3.

*Figures 4 to 6* are diagrams similar to Figs. 1 to 3, but showing how cups may be initially formed without any locking means. Then at the second place, after the supply of ingredient, the application of a tool 4 serves to deform not only the lower cup, but also the middle cup, thereby simultaneously producing the upper, inner locking means of the lower cup, and the lower, outer locking means of the middle cup. Furthermore Figs. 4 to 6 serve to illustrate that the locking means may be at a lower level than in Figs. 1 to 3. That is to say, referring to Fig. 12, Fig. 12 itself, and Figs. 1 to 3, show locking means located in an upper zone *a* of the sidewall, above a finger-gripping zone *b*, whereas Figs. 4 to 6 show that locking means may be formed in a lower zone *c* of the sidewall, this being the zone which also surrounds the ingredients 10. It is of course necessary to ensure that the heat in the tool 4, while sufficient to enable the necessary deformation of the sidewalls to occur, does not harm the ingredient,

The application of heat and pressure by the tool 4 in Figs. 4 to 6 may serve to produce outer and inner locking means, purely by mechanical deformation of the sidewalls, the resultant locking means being in mechanical interengagement, or it may produce retaining by some degree of welding between the sidewalls of the lower and middle cup, in which case there may be little or no mechanical deformation of the sidewalls, particularly of the middle cup, (i.e. the cup with the sidewall further from the tool 4).

*Figure 13* shows a cup which differs from Fig. 12 and Figs. 1 to 3 in that the lower, outer locking means is an external rib. Fig. 7 shows how such locking means cooperates with an internal rib on a lower cup.

*Figure 14* is a side elevation, with a fragment in radial section, of a cup of the "inverted base" type (in the section the thickness of material is much exaggerated). In this cup, the bottom wall 2 is above the lower boundary of the sidewall. Consequently, over the lower zone *c*, the sidewall is re-entrant.

Such cups are supplied with ingredient while in inverted position, as shown in Fig. 8.

Figs. 1 to 3 and Figs. 4 to 6 illustrate a procedure in which successive cups are added to the bottom of a stack. Fig. 8 involves adding successive cups to the top of a stack. Fig. 9 illustrates another procedure in which successive cups are shaped somewhat as in Fig. 12, but are added successively to the top of the stack. In this case, the cup is formed initially with upper, inner locking means, constituted by an internal rib, and a tool 4 is inserted through the mouth of the cup, and then moved outwards in order to deform the sidewall and thus produce a lower, outer locking means in the form of an external rib.

Fig. 10 illustrates a combination of the thinking of Figs. 8 and 9.

Fig. 11 illustrates a procedure in which retaining takes place at a position spaced below the rim of each cup by a distance less than the stacking height. This being so, it is possible to postpone the formation of the upper, outer locking means, until after a stack of cups has been assembled. Each cup already has a lower, outer locking means in the form of a groove 7, as in Fig. 12, and the upper, inner locking means of all the cups, in the form of an internal rib 6, is produced by a multiple tool 4.

The tool 4 may operate in a number of alternative ways. It may be a roller which travels round the cup, thus producing a retaining means progressively. It may be in the nature of an iris diaphragm, which produces the entire retaining means simultaneously around the circumference of the cup. It may be in the form of several plungers which produce a retaining means in the form of a series of circumferentially spaced deformations or welds, rather than a circumferentially continuous deformation or weld.

The description so far has been of single-walled cups. The invention may also be applied to double-walled cups, provided that the tool is capable of acting on one wall through the other wall, that is to say either deforming both walls, or imparting sufficient heat through both walls to cause welding of the further wall to the next cup.

## CLAIMS

1. A method of making a cup of deformable material capable of nesting with identical cups to form a stack, the cup comprising a bottom wall and a sidewall extending generally upwards and outwards from the bottom wall, the cup including lower, external and upper, internal retaining means which, when an upper and a lower cup, in upright attitude, are in nesting engagement, cooperate to resist separation of the cups, but nevertheless to permit the cups to be separated by external forces, the method comprising forming the cup without one at least of the retaining means, and thereafter producing the absent retaining means by local application of heat and force to the sidewall of the cup.

2. A method according to claim 1, in which the retaining means is outer and inner locking means which cooperate with locking means of identical cups by mechanical inter-engagement.

3. A method according to claim 2, in which the lower, outer locking means is an internal rib on the sidewall of the cup, and the upper, inner locking means is an external groove in the sidewall.

4. A method according to claim 1, in which the retaining means comprises welding between adjacent cups.

5. A method according to any of claims 1 to 4, in which the cup is formed without any retaining means.

6. A method according to any of claims 1 to 5, in which the production of the absent retaining means is carried out after supplying powdered ingredient to the cup and nesting the cup with an identical cup so that the ingredient is in the space defined between the bottom walls of the cups.

7. A method according to any of claims 1 to 6, in which the absent retaining means is produced by application of a tool to the outside of the sidewall of the cup.

8. A method according to any of claims 1 to 6, in which the absent retaining means is produced by application of a tool to the inside of the sidewall of the cup, inserted through the mouth of the cup.

9. A method according to claim 7 or claim 8, in which the cup is of a thin thermoplastic material, and the tool is heated.

10. A method according to any of claims 7 to 9, in which the tool is a roller which travels round the cup.

11. A method according to any of claims 7 to 9, in which the tool produces circumferentially spaced portions of retaining means.

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